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Notice of Allowability

Application No.

10/785,395

Examiner

Gordon J. Stock

Applicant(s)

MIEHER ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to amendment filed 5/8/07.
2. ☒ The allowed claim(s) is/are 1-10, 12.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|--|---|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____ |
| 3. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date <u>20070508</u> | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input checked="" type="checkbox"/> Other <u>PTOL-413B</u> . |

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DETAILED ACTION

1. The Amendment received on May 8, 2007 has been entered into the record.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on May 8, 2007 has been considered by the examiner.

Drawings

3. The Drawing received on May 8, 2007 is accepted by the Examiner.

EXAMINER'S AMENDMENT

4. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Attorney Mary Olynick on May 22, 2007. Please see attached PTOL-413B. **Claim 1** is amended. And the specification has been amended to correct a grammatical error and typographical error on page 31.

On page 31 of applicant's specification please replace the paragraph beginning on line 3 with the following amended paragraph:

The measured signal is represented by a set of even periodic functions with a corresponding number of free parameters (one of these free parameters is the overlay error itself). For example, each measured signal may be represented by a Fourier series expansion

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having any number of terms consistent with the number of targets measured. The number of terms depends on the number of targets measured, scatterometry signals properties, target properties, and information required. In a Fourier series having three terms, a measured signal may be represented by:

$$k + l \cos(2\pi/P (V_i + E)) + m \cos(4\pi/P (V_i + E))$$

where k is a constant; l is an amplitude of the first harmonic; m is the amplitude of the second harmonic; V_i represents the predefined offset; P is the period; and E is the overlay error. The number of targets measured is to be greater or equal to the cumulative number of free unknown parameters in the chosen function. In the above three term example, there are four unknowns; k, l, m, and E where the period is 360 degrees or 2π radians. Therefore, four targets may be used to solve for the four unknowns which include overlay E.

The Amended claim:

1.(Currently Amended) A method of determining an overlay error between two layers of a multiple layer sample, the method comprising:

for each of a plurality of periodic targets that each have a first structure formed from a first layer and a second structure formed from a second layer of the sample, measuring a plurality

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of optical signals at a plurality of incident angles, wherein there are predefined offsets between the first and second structures; and

determining and storing, in memory, an overlay error between the first and second structures by analyzing the measured optical signals at the plurality of incident angles from the periodic targets using a scatterometry overlay technique based on the predefined offsets without using a calibration operation or a model-based regression technique,

wherein the scatterometry overlay technique is a phase based technique that includes representing each of the first and second optical signals as a set of periodic functions having a plurality of ~~measured~~ known parameters, ~~which are obtained from the each measured optical signal~~, and an unknown overlay error parameter and analyzing the set of periodic functions to solve for the unknown overlay error parameter to thereby determine the overlay error.

Allowable Subject Matter

5. **Claims 1-10 and 12** are allowed.

The following is an examiner's statement of reasons for allowance:

As to **claim 1**, the prior art of record, taken alone or in combination, fails to disclose or render obvious in a method of determining an overlay error the particular phase based technique that includes representing each of the measured first and second optical signals as a set of periodic functions, in combination with the rest of the limitations of **claims 1-4, 7-10, and 12**.

As to **claim 5**, the prior art of record, taken alone or in combination, fails to disclose or render obvious in a method of determining an overlay error determining a second overlay error

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by comparing the measured optical signals to theoretical data, in combination with the rest of the limitations of **claims 5-6**.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Fax/Telephone Numbers

If the applicant wishes to send a fax dealing with either a proposed amendment or a discussion with a phone interview, then the fax should:

- 1) Contain either a statement "DRAFT" or "PROPOSED AMENDMENT" on the fax cover sheet; and
- 2) Should be unsigned by the attorney or agent.

This will ensure that it will not be entered into the case and will be forwarded to the examiner as quickly as possible.

Papers related to the application may be submitted to Group 2800 by Fax transmission. Papers should be faxed to Group 2800 via the PTO Fax machine located in Crystal Plaza 4. The form of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The CP4 Fax Machine number is: (571) 273-8300

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gordon J. Stock whose telephone number is (571) 272-2431.

The examiner can normally be reached on Monday-Friday, 8:00 a.m. - 6:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr., can be reached at 571-272-2800 ext 77.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private Pair system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MD

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May 23, 2007

Gregory J. Toatley, Jr.
Supervisory Patent Examiner
Art Unit 2877


Gregory J. Toatley, Jr.
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